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HOW NEW FM DETECTORS WORK*

Servicers Must Learn to Spot These Demodulator Circuits at a Glance

The lag between the exciting news of the arrival of FM and the actual placing of receivers into the hands of the public has had an inevitable reaction of disappointment upon a number of servicers. This is especially true for some of those men who are in areas where FM is only first going on the air. The attitude, expressed as "I'll think about it if and when it comes," has lulled such technicians into a state of complete lack of technical preparation for FM which, suddenly, is here now in a big way.

No doubt it is perfectly true that a chain is as strong as its weakest link, and thus no one portion of an FM receiver may be termed the "key" circuit. Nevertheless, in practice, only a few parts of the schematic are unfamiliar to trained servicers of AM radios. It is these parts, requiring somewhat unusual techniques and relatively strange theory, which will become the weak links in many a servicer's early experience with FM.

From this point of view, then, it can be said that FM detectors are one of the "key" circuits for radiomen to study, in preparation for the work to come. In fact, even those men who whether by virtue of general interest in new radio circuits or because of training in the armed forces have already studied FM discriminators some years ago, will be wise to re-examine their knowledge today. For the fact is that at least four different and separate FM detectors are in very wide use at present, and the ability to identify the type used, let alone make the proper adjustments and interpret the measurements taken, is a must for efficient servicing.

The newest FM detector to see mass production is known as the FreModyne. Because it will be discussed in detail in a future issue, its principles of operation will be skipped here. On the other hand, the oldest FM detectors, rarely seen today, used rather intricate circuits, including double-tuned slope

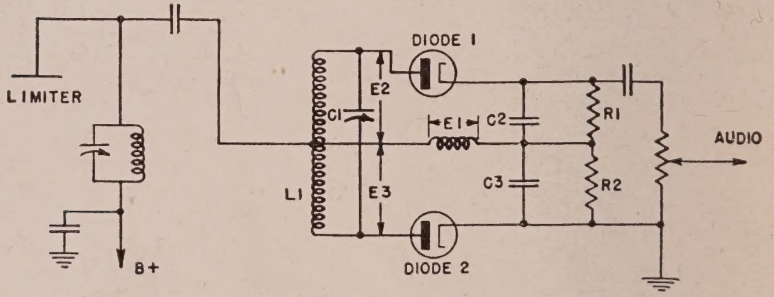


Fig. 1. So-called "conventional" discriminator found in numerous receivers delivers audio from series connected load resistors.

* Courtesy of Radio & Television Retailing.

detection. Three remaining types, all in popular use, are: the discriminator, the ratio detector, and the locked oscillator. The explanation and illustrations reprinted from General Electric's new booklet on FM service, bring out the essential differences in a very clear manner.

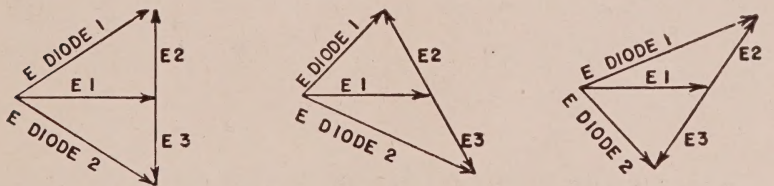
Figure 1 shows the "conventional" discriminator which consists essentially of two diode rectifiers differentially connected so that the d-c potentials across their respective load resistors are subtractive. These two d-c voltages (across R1 and R2 in figure 1) are proportional to the a-c voltages applied to the diodes. The a-c voltage applied to each diode is the vector sum of E1 and the voltage across that half of L1 which is connected to the diode plate, as shown in the diagrams in figure 2. E1 has practically the same amplitude and phase as the voltage across the tank in the limiter plate circuit. The current in this tank induces a voltage in L1, which causes circulating current to flow in the resonant circuit composed of L1 and C1. E2 and E3 are the voltage drops which occur across each half of L1 as a result of this circulating current. When the carrier frequency is equal to the frequency at which the discriminator transformer is tuned (figure 2A), the a-c voltage applied to diode 1 equals that applied to diode 2, therefore the rectified voltages are equal and since they are bucking voltages, the output of the discriminator is zero.

When the carrier frequency increases during a half cycle of modulation, the phase relations between E1, E2, and E3 change in accordance with figure 2B, and it is evident that the vector sum of the voltages applied to diode 2 exceeds the vector sum of the voltages applied to diode 1; this results in a higher rectified voltage across R2 than R1. The instantaneous difference of the rectified voltages appears as a negative voltage in the discriminator output. Figure 2C shows the condition occurring when the carrier frequency swings below the resonant frequency of the discriminator transformer, the end result being a positive voltage at the output of the discriminator.

The important fact in discriminator action is that the output voltage is proportional to the difference between E diode 1 and E diode 2. This is true because the d-c voltages appearing across R1 and R2 vary directly with E diode 1 and E diode 2. This is true and the instantaneous output voltage is the difference between the rectified voltage drops.

Effects of Amplitude

In considering the effect of amplitude variations on the discriminator output, refer again to the vector diagrams of figure 2. An increase in the amplitude of the voltage applied to the discriminator would increase all the vectors in the diagram proportionately. In other words, the effect would be as though the vector diagrams were enlarged photographically. It can be seen that while the phase relationships would remain the same, the difference between E diode 1 and E diode 2 would increase, so long as the frequency of



A - Carrier Freq. at I.F. B - Carrier Freq. above I.F. C - Carrier Freq. below I.F.

Fig. 2. Phase relations of the generating and resultant voltages in FM discriminators and ratio detectors.

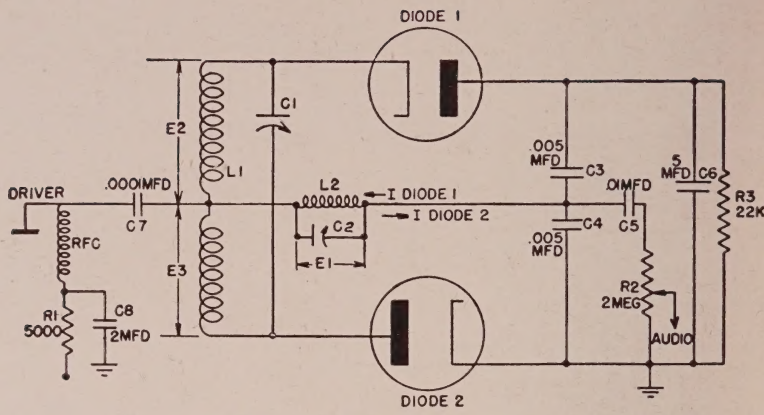


Fig. 3. Ratio detector has same relations between generating and resultant voltages as discriminator, but audio voltage is developed across series capacitors C3-C4.

the applied voltage differed even slightly from the receiver IF. Thus, components of amplitude modulation would be detected and passed on to the audio amplifier. Ordinarily, discriminators are preceded by limiters which remove most of the amplitude variations as shown in the preceding pages, but the discriminator itself is not a device capable of rejecting amplitude modulation, except when the instantaneous frequency of the applied carrier is exactly equal to the resonant frequency of the discriminator transformer.

A new device now appearing in postwar FM receivers is the ratio detector. This circuit also converts a frequency modulated carrier into an audio signal but has the additional advantage of being inherently insensitive to amplitude modulation. This characteristic enables the ratio detector to be used without the usual preceding limiter stage thus affording the use of a high gain IF stage instead of the low-gain limiter.

A schematic of the fundamental ratio detector is shown in figure 3. C3, C4, and C7 have very little reactance at the intermediate frequency, so it is evident that the parallel resonant circuit L2-C2 is the true load for the driver stage, this stage being shunt fed. A driver stage, in this case, is nothing more than a conventional IF amplifier preceding the ratio detector. L2 is inductively coupled to L1, therefore a comparison of figures 1 and 3 will show that as far as the a-c voltages applied to the diodes are concerned, these circuits are almost exactly similar and the same vector diagrams used in the analysis of figure 1 can be used to portray the a-c voltages across the diodes of figure 3.

Here the similarity ends, because the ratio detector method of extracting intelligence from the FM carrier differs greatly from previously used methods. Diode 1, R3, and diode 2 complete a series circuit fed by the a-c voltage across L1. Since the two diodes are in series, they will conduct on the same half cycle, and the rectified current through R3 will cause a negative potential to appear at the plate of diode 1. The time constant of R3-C6 is usually about .2 second, so that the negative potential at the plate of diode 1 will remain constant even at the lowest audio frequencies to be reproduced.

C3 will be charged by the rectified current through diode 1 to a voltage

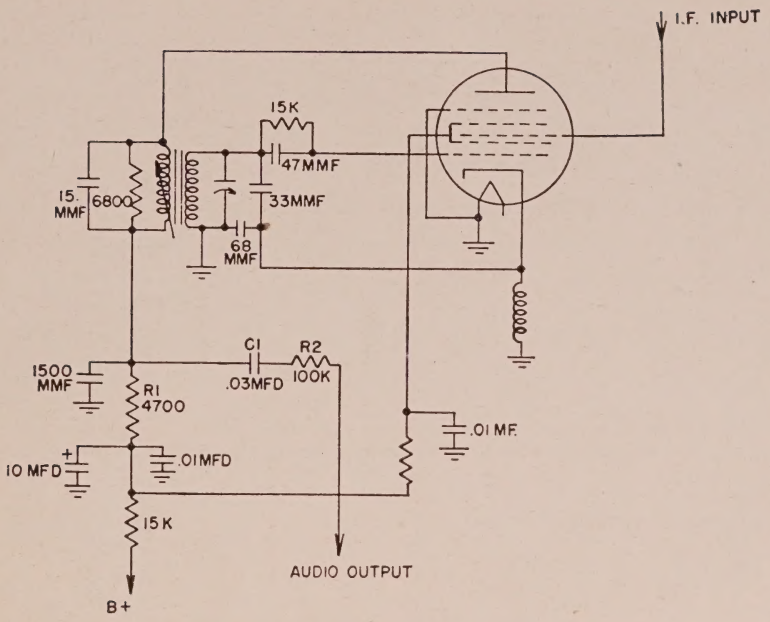
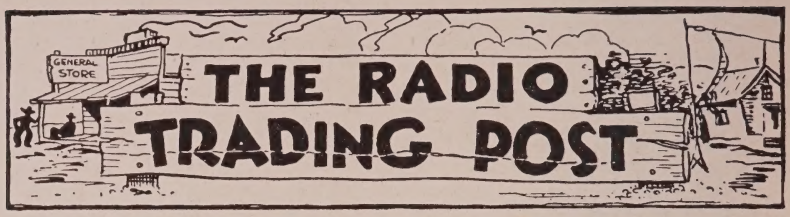


Fig. 4. A locked oscillator circuit, operating on a principle completely different from both ratio discriminators and detectors. Incoming i-f signals cause plate current variations.

proportional to the voltage represented by vector E diode 1 (figure 2), and C4 will be charged through diode 2 in proportion to the vector E diode 2. Since the magnitudes of these vectors differ according to the instantaneous frequency of the carrier, the voltages across C3 and C4 will differ proportionately, the voltage across C2 being the larger of the two voltages at carrier frequencies below the IF and the smaller at frequencies above the IF.

Note that the voltages across C3 and C4 are additive and that their sum is fixed by the constant potential across R3. Therefore, while the ratio of these voltages will vary at an audio rate, their sum will always be constant and equal to the voltage across R3. The potential at the junction of C3 and C4 will vary at an audio rate when an FM carrier is applied to the detector, hence audio voltage is extracted at this point and fed into the audio amplifier. The rejection of amplitude modulation in the ratio detector may be explained as follows: A rapid increase in the amplitude of the carrier applied to the ratio detector will tend to increase the d-c voltages across C3 and C4. The sum of these voltages must always be equal to the voltage across C6. The voltage across C6 cannot change with a rapid increase in the amplitude of the carrier, due to the large time constant of R3 and C6. Therefore, this constant potential across C6 prevents the voltages across C3 and C4 from rising with an increase in the strength of the carrier. A reduction in carrier amplitude is prevented from appearing as

(Continued on page 15)



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FOR SALE — Millen R9, like new, $20; Ghirardi's "Radio Trouble Shooters Handbook" and "Modern Radio Servicing," both, $5; National NC-46 and speaker, excellent condition, $85. Martin Herbstman, 1806 Sterling Pl., Brooklyn 33, N. Y.

SELL OR TRADE — BC 342 receiver, for 3 inch scope, or will take $49. Signal tracer; vacuum tube volt ohm meter, unfinished, all parts mounted; amplifier P.P., all complete with tubes. Want Riders Manuals 10, 13, 14, Nov., 1946 Radio News. G. J. Vervilos, Rt. 5, Box 6066, Sacramento, Calif.

SELL OR TRADE — All BC-348 Official Handbooks, $1.25; Weston 301 meters 0-1 ma., $3; other ranges at same price. Write for full list. Want C-D "BF" analyzer W. H. Strader, 27 E. Orchard Rd., Covington, Ky.

WANTED — Job in repair of radios, or anything to do with radio. Young, Navy veteran, married. Graduate school of radio and television. Edwin Schafer, 1108 Clay Ave., Bronx 56, N. Y.

WANTED — 8 or 16 mm. movie camera. State condition, make, model, price. Will sell or trade German Foth Derby F2.5 focal shutter and German folding Agfa F4.5 solinar lens, 116 film. Jack Heller, 2643 N. Washtenaw, Chicago 47, Ill.

WANTED — U. S. or foreign stamp collection or accumulation. Will swap large stock of radio equipment, parts, tubes, and test equipment. B. Bernbaum, 5746 North Park Ave., Philadelphia 41, Pa.

SELL OR SWAP — Hand ground and polished 6" reflecting lens, 1/2" f.1 eyepiece, tube and cell. Also 3000 foreign and U. S. stamps. Mort Rosen, 3219 Neptune Ave., Brooklyn 24, N. Y.

FOR SALE — Supreme Audolyzer, model 562, like new, $90; Triplett model 1200A volt-ohm-milliameter, $20. John T. Hayes, 302 Beideman Ave., Apt. 165, Camden, N. J.

FOR SALE — Radio City Products model 414 analyzer, $30; Hickok model 134 analyzer, like new, $50. S. G. Vervilos, Rt. 5, Box 6066, Sacramento, Calif.

FOR SALE — Wilcox-Gay model JA-10 portable Recordio and PA system, complete with 12" auxiliary speaker, case, and cord, De-Luxe floor stand for microphone, $225. Herbert Wojahn, Fraine Barracks, Bismarck, N. Dak.

FOR SALE — No. 813 tube, $4.50; 100 watt xmitter for 10, 20, 80 meter phone, $75; other items. Frank H. Carlson, New London, Iowa.

WANTED — Information and diagrams for all types of radio geophysical metal and ore detecting equipment; diagrams for hi-fidelity PA systems, dual and single channel types. Vernon J. Kahanek, 413 West Texas, Midland, Tex.

FOR SALE — Altec 603 speaker, $50; Shure 55A microphone, $25; Electrovoice 950 microphone, $18; Electrovoice 605 microphone, $10; 4 channel pre-amp, $50; miscellaneous transformers, low Z 4 channel portable amplifier. Gordon Gray, 945 Verdugo Circle Dr., Glendale 6, Calif.

POSITION WANTED — As broadcast engineer in college town or city having good television school. Age, 19, married, 6 years radio, broadcast engineering experience. Housing essential. Edward Howell, Gen. Del., Gastonia, N. C.

TRADE — Quality printing for testing equipment, Riders or other books of scientific or educational nature. R. A. Stratton, 3010 Harrison St., Waco, Tex.

FOR SALE — 350 W. 110 V. A.C. gasoline power plant, guaranteed perfect. Has D.C. tap for charging 6 and 12 volt batteries, $155 F.O.B. Also one 500 W. for $215. Harold E. Young, 700 Seventh Ave., New Brighton, Pa.

SELL OR SWAP — National FB-7 receiver, new tubes and power supply, all coils included. Need pocket V.O.M. or $15. Robert W. Johnson, 6505 Ridgewood Ave., Chevy Chase 15, Md.

FOR SALE — Custom built electronic equipment. Constructed to your specifications using your parts or parts supplied by us at cost. Send us your specifications or rough drawings for estimates. Lakewood Laboratories, 545 Aberdeen Ave., Dayton, Ohio.

WANTED — Saturday work in Melvindale or suburban towns. Experience serviceman in radio, PA installation, changers, etc., with anyone with proper equipment. Gus Bertolino, 2570 Corbin, Melvindale, Mich.

WANTED — Navy or Army wire recorder, either magazine or spool type, extra magazines, or spools and wire. State voltage, price and condition. Sol Feigelman, 62 West 52 St., New York 19, N. Y.

SELL OR TRADE — Late De Forest's training Course, Enlisted Men's Radio Technical Training Course, 1947 Radio Craft and other radio magazines. Want capacitor tester, Riders Manuals, battery eliminator. Philip H. Alden, 2401 Ulrich Ave., Dayton 6, Ohio.

FOR SALE — 1938 model signal shifter with tubes and 10, 20, 40, 80, 160 meter coils. Good appearance, working condition. Randolph E. Neal, Westminister, Mass.

FOR SALE — Nationally known tubes in original cartons, as much as 65% off list price. Send for free list. Will swap for BC-348 converted to 110 VAC. W. E. McClendon, 899 4th Ave., Yuma, Ariz.

SELL AND WANTED — Mallory type 56-1C synchronous vibrators; parts for 200 watt transmitter; Parmetal enclosed cabinet, 38" high; assorted high voltage mica condensers for sale. Want 60 type 6B5G tubes. W. F. Shanley, 428 Stratford Rd., Brooklyn 18, N. Y.

FOR SALE — Used speakers and parts. Send for list. M. A. Porter, 1709 N. Larrabee St., Chicago 14, Ill.

FOR SALE — 43 good tubes; Supreme Voltmeter, model 333; Approved signal generator, model A-200. Alex Zeitlin Radio Service, 142 Lincoln Ave., Bridgeport 6, Conn.

WANTED — Old Coins, old U. S. money. Especially want gold coins and commemorative half dollars. Send me yours for my offer. H. Breed, Jr., 2500 Ave "G", Birmingham, Ala.

SWAP — Westinghouse 2 speed charger, good violin, Evans lighter, big box beads for beadwork, N.R.I. and Radio Engineering courses for anything. Victor D. Letourneau, Jr., 179 Main St., Holyoke, Mass.

SELL OR SWAP — Shure model 717A crystal microphone, 16 ft. shielded cord with standard plug; Chemcraft No. 25 chemistry set with extras. Make offer. Want electronic photoflash equipment. John Poirier, Harlowton, Mont.

FOR SALE — Riders Manuals 7, 8, 10-14, with index and record changer manual, all in very good condition. Price, $65. Wm. C. Brown, 565 N. Buckeye St., Wooster, Ohio.

FOR SALE — Readrite 432A tube tester, guaranteed like new, extra charts, $20; VTVM and multimeter used by N.R.I. reads to 100 megs., $15, excellent condition. Jack Marley, Bedford, Iowa.

FOR SALE — A.C.-D.C. multimeter ,uses 4 inch meter, perfect condition. Price, $14.75 postpaid. L. Wienreb, 151-09-34th Ave., Flushing, Long Island.

SELL OR SWAP — 48" wood turning lathe. 11" swing, ball bearing, 3-speed head, complete with chisels, $25 or good camera or skiis. Don Hegranes, Grafton, N. Dak.

FOR SALE — 2 12" speakers in RCA portable complete, $40; 12" RCA speaker, $20; S-40 receiver, $75; Kodak 35 range finder, complete with case, $72. Want Speed Graphic, any size or condition. Ray Barbieri, 2261 Creston Ave., Bronx 53, N. Y.

FOR SALE — A.C. Superhet chassis, 8" PM speaker, good working order, needs cabinet, $23; pair Carl Zeiss Jena 8 x 30 Detrintem binoculars, excellent, $120; RCP signal generator, model 705A, excellent condition, $45. Pete Kacouse, 148-09 Jamaica Ave., Jamaica 2, L. I., N. Y.

FOR SALE — Complete N.R.I. Radio, FM, Television Course, beautifully bound in 2 volumes. Best cash offer. Harry Steinberg, 2200 Tiebout Ave., New York 57, N. Y.

WANTED — Following magazine: CQ for Feb., May, Oct., 1946, May, 1947. Also need ARRL special wartime edition of the handbook. Milton Kalashian, 2 Congress St., Newburyport, Mass.

SELL AND WANTED — RCP signal generator, model 760; Supreme tube and set tester, model 504 for sale. Want complete schematic for R5-ARN7, BC453, BC966 I.F.F. Johne's Radio-Television, 1803 N. 4th St., Sheboygan, Wis.

WANTED — SCR-274-N handbook for Unit BC-969-A. British periodicals sent in exchange. David Mitchell, G.P.O. Box 4, Colwyn Bay, Wales, Great Britain.

FOR SALE AND WANTED — Winchester .22 repeater, like new, $20. All types of rifles and pistols bought and sold. Prompt service in custom gunsmithing, remodeling of foreign and service rifles. Dan Waranius, Carney, Mich.

FOR SALE — Weller 100 watt soldering guns, $8.95. Send money with order. B. Baker, 2502-39th, Galveston, Tex.

WANTED — Manuals on maintenance and repair of surplus radio receivers AN/ARR-5 (R-44) and AN/ARR-7 (R-45). Also Technical Manual TM-11-850N. State price wanted and condition. Willard W. Davis, 10 Temple St., Gloversville, N. Y.

FOR SALE — Guaranteed perfect radio tubes at 70% off list prices. Cash or C.O.D. Write for list. H. A. Bescheinen Radio Service, Loose Creek, Mo.

TRADE — Midget radio meters; 350 5 and 10 watt resistors; 104 amperite ballast tubes; 38 ICA universal line cords. I need tube checker, oscillator, multimeter in good condition. G. D. Griffin, Box 20, Ithaca, N. Y.

SELL OR SWAP — Large assortment of equipment from college amateur lab. First reasonable offer. German Mauser rifle, good condition, with ammunition. Want guitar, or what have you? Sheldon Freud, 414 Beach 122 St., Rockaway Park, N. Y.

SELL OR SWAP — Professional model laboratory microscope, excellent condition. Want good communications receiver, ham equipment, or cash. Lee Capehart, 3118 Sutton, Maplewood 17, Mo.

FOR SALE — Bud model VFO-21 variable frequency exciter for amateur transmitter, complete, grey streamlined cabinet. Price, $30. Ellsworth Radio Shop, 520 West Empire, Freeport, Ill.

WANTED — Instruction book or manual for Triplett model 1175B all wave servicer. Cash or will trade for complete outfit. Arch G. Newbern, Bremen, Ga.

SELL OR SWAP — Leica II, Elmar f3.5 lens, to 1/500 shutter, yellow filter and case, A-1 condition. Price, $100, or will trade for telephoto lens coupled for Leica. F. W. Nichols, 314 So. MacArthur Blvd., Springfield, Ill.

FOR SALE — Precision E200 signal generator, $35; Clough Brengle model 130 A.C. bridge condenser checker, $20; Precision 920P tube and set checker, $60. All in good condition. W. H. Vallette, 503 So. Wheaton Ave., Wheaton, Ill.

SELL OR TRADE — Supreme model 450 tube tester, like new, $30; all types of tubes in original cartons, 50% off list. Need modern portable typewriter. S. Altzman, 222 S. 59th St., Philadelphia 39, Pa.

FOR SALE — Webster-Chicago automatic record changer, model 50, complete, perfect condition and in original carton. Satisfaction guaranteed, $30. Robert Wiener, 1848 Bryant Ave., Bronx 60, N. Y.

SELL OR TRADE — Zenith 6 volt vibrator packs, $3 each; Pfleuger Supreme casting reel and Heddon Pal rod, $55; Shakespeare glass rod. Want guns or Hickok model 288X signal generator. Frank E. Popma, Orange City, Iowa.

SELL OR SWAP — BC-221 frequency meter, $25; BC-348 receiver converted to 110 A.C., good condition, $55; Vomax, new condition, $55. Need Riders, condenser checker, signal generator. E. G. Schwartz, 134 Weber St., Havre de Grace, Md.

TRADE — 500 ohmite, 200 volt wire-wound 10 watt resistors. Want service manuals, test equipment, radio parts. W. C. Rhone, 3745 Blanche St., Pasadena 10, Calif.

FOR SALE — A-100 Electronics approved signal generator, like new, $33.25; Simpson voltmeter, $28; tubes, 60% off list; Silver Vomax signal tracer, like new, $40. Allen Silver, 90 Spruce St., Newark, N. J.

SELL OR TRADE — Receiving tubes, 60% off list; Jap 6 shot revolver; perfect condition; Belton portable radio without tubes; complete Mallory Manual, 1937 diagram manual. Want guns, radio equipment. Morton Berndt, P. O. Box 236, Du Pree, S. Dak.

SELL OR TRADE — 1 meg-ohm, 1 watt precision resistors, 60 cents each, 3 for $1.50; Selsyn motors, made by Bendix, 50 volts, 50 cycle, $4 a pair. Murray Fisher, 4929 Old York Rd., Philadelphia, Pa.

WANTED — Complete schematic for Mark II Tank xmitter-receiver (40, 80 meters, 235 mc.). Don Anderson, 917 East Kemp, Watertown, S. D.

SELL OR SWAP — Hallicrafters S-20R, excellent condition, recently checked and aligned. $45 F.O.B. or swap for photographic equipment. P.O. Box 502, Valparaiso, Ind.

FOR SALE — Five tube receiver, Goodyear "Wings" model 540 superhet, in good operating condition, just aligned. Price, $15 F.O.B. William N. Gebhardt, Orrville, Ala.

FOR SALE — Webster model 80 wire recorder, like new, with instructions, extra spools of wire, microphone, $125. L. Wszolek, 3220 So. Morgan St., Chicago 8, Ill.

FOR SALE — G.E. model TC3-P tube checker, late model, checks all tubes. Price, $50, delivered. National Radio Service, 379 Merritts Ave., N. E., Atlanta 5, Ga.

FOR SALE — Tubes in cartons, 60% off list. Write for list. Community Radio Sales, 2300 Bronx Park East, Bronx, N. Y.

SELL OR TRADE — Complete 8 mm. home movie outfit, splicer and accessories. Trade for Espey television kit, 5" scope, SX-25, cut film camera, or a standard microscope. Peter Bedrosian, 2 Unicorn St., Newburyport, Mass.

FOR SALE — 10 meter Gonset converter, $30; MK-2 No. 19 transceiver, set of spare tubes, control boxes, cables, spare parts, etc., $100. Thomas E. Conrad, 4413-17th St., N. W., Washington 11, D. C.

WANTED — Used table model radios and guitar amplifier. V. R. Hinthorn, Hinthorn Radio Shop, El Paso, Ill.

WANTED — 16 mm. and 35 mm. sound and silent projectors and film. Will swap radio gear. Ed Howell, Gen. Del., Gastonia, N. C.

WANTED — Good signal generator, must have modulation externally available. Baron V. Huene, 72 Kirin Road, Tientsin 1, China.

SELL OR TRADE — About 65 back issues of Q.S.T., from 1930 to 1946, good condition. Leo Raboy, 1801 Longfellow Ave., Bronx 60, N. Y.

FOR SALE — Two rack mounted 300 watt transmitters, extra power supplies, 1250 volt 300 mil., and spare 6 foot enclosed rack. All excellent condition. Carl J. Visenti, 352 West 115th St., Chicago 28, Ill.

FOR SALE— 8 tube tablemodel short and long wave receiver, A.C., good performance; 5 round meters. Make offer. Lora-Elve Radio, 2159 Southern Blvd., Bronx 60, N. Y.

FOR SALE — Hickok RFO-5, used but few times, $100. William Porter, 916 Main St., Lafayette, Ind.

SELL OR SWAP — Jap field radio equipment, xmitter, hand generator, microphone and head set, all in good condition. Want good oscilloscope or what have you? Wesley W. Harris, Box 174, Manette Sta., Bremerton, Wash.

TRADE — National PWO, right angle drive without dial, perfect condition, for NPW-O, drive shaft perpendicular to panel, in same condition. All replies answered. Jerry Litwak, 521 N. Glassell, Orange, Calif.

WANTED — Battery short wave receiver, with power pack plug, prone and speaker plug and recorder plug. Must be in perfect working condition. George Neuschafer, P. O. Box 883, Kerrville, Tex.

WANTED — Riders Manuals, except X and XIII. Have television set assembled with or without tubes, Remington typewriter, etc., in exchange. Emery G. Lang, 82 W. 165th St., Bronx 52, N. Y.

FOR SALE — Edwards Fidelotuner F.M. tuner, 5 tubes, in original carton. Price, $27.50 postpaid. Virgil Johannes, 1541 Metropolitan Ave., Bronx 62, N. Y.

POSITION WANTED — Experienced radio and sound technician, capable of first class work. Want work in Kansas or bordering states. State conditions and wage in first letter. Wm. Porter, c-o Gordon Porter, 1006 No. 10th St., Lafayette, Ind.

FOR SALE — Portelec portable transcription player and P.A. system; Hallicrafters S20R receiver; Masco 25 watt amplifier; 2 table model changer cabinets. Write for details. W. Salyers, 3334 Hammond, Fresno, Calif.

FOR SALE — 920 Precision tube and set tester; radio and ballast tubes; fluorescent lamps; record players; microphones; Bell transformers; Selectron electric time clock; radio parts. Community Radio & Electric Service, 300 N. Centre St., Cumberland, Md.

WANTED — Late model V.O.M. tube checker, or combination of both. State model, condition and price. B. Lutwick, 168 East 95 St., Brooklyn 12, N. Y.

SELL OR SWAP — Maintenance manuals for BC-348, ART-13A, SCR-718, APN-1, APN-4, APN-9, ARA-10, ARC-3, ARN-11, $2 each. Want manual for BC-431A and TS-32B. John Riley, 310 N. Normandie Ave., Los Angeles, Calif.

FOR SALE — Meissner 3 tube regenerative receiver, 550 kc. to 15 mc., complete with tubes. Otto Pollei, Jr., 2122 Edgeland Ave., Louisville, Ky.

FOR SALE — .45 caliber Reising model 60 automatic rifle with box of tracer ammunition, $40; portable 5 tube battery receiver, 2 to 6 mc., $20. Paul H. Trautwein, 625 26 St., Rock Island, Ill.

FOR SALE — 1200 Mallory type MR 50 volume controls, 3" shaft extension, 32 cents each. 1200 Mallory attachable switches, single pole, single throw type M26, 11 cents each. O. W. Noeske, 1644 N. 28 St., Milwaukee 8, Wis.

WANTED — Cut-film septums to fit 3-A Compact Graflex film magazine, or complete magazines that size. Cash, or will trade radio and photo books and other items. Eugene P. Hanafin, Jr., 3847 S. Broadway, Los Angeles 37, Calif.

WANTED — Transformer from 220 volts to 110 volts, any rating. Must be in good condition. Nelson K. Stover, 1357 Hill St., York, Pa.

SELL OR TRADE — Large list of radio tubes; transformers. Write for details. Want wireless oscillators in working condition or Riders Manuals, any volume. Sadler Radio, 4130 E. 12, Kansas City, Mo.

WANTED — G.R. or H.P. wave analyzer. Advise cost and condition. Paul H. Thomsen, 2028 Thurman Ave., Los Angeles 16, Calif.

FOR SALE — Philco tube tester, model 7050, like new, $40. W. C. Montgomery, 4219 Pitt St., New Orleans 15, La.

SELL OR SWAP — Numerous radio chassis, complete; radio parts; 2 G.E. resolvers for 110 volt A.C., $10; Meissner S.W. radio, $10; Test-Rite BC-45 signal generator, $25. Want television set, oscilloscope and FM, communications, receiver. Paul Mathews, Bloomingdale, N. J.

TRADE — Model 1849 Springfield muzzle loading shot gun in good shape, for tube tester, signal tracer, or what have you? Laurence Walker, Route 1, Galena, Kan.

WANTED — Position with radio serviceman or any radio work, vicinity of Morris County preferred. Navy Veteran, experience approximately 30 W.P.M., graduate Jersey City Tech. F. N. Vanderhoof, Box 136, Morris Plains, N. J.

SELL OR SWAP — Sprayberry Academy Radio Course for auto radio; Temple 8-60 receiver with power pack, whole or parts. Robert Winstanley, 607¼ Belmont Ave., Los Angeles 26, Calif.

FOR SALE — Television diagrams, Transvision, RCA, Philco, Viewtone, Electrotech, 35 cents each, or 3 for $1. Cabinet used in 7" RCA television receiver, $10. L. Freedman, 2064 Ocean Parkway, Brooklyn 23, N. Y.

FOR SALE — N.R.I. Professional signal tracer, model 33, instruction book included, new condition. Make offer. Geo. G. Lau, 147 N. 3rd St., rear, Hamburg, Pa.

SELL OR TRADE — Latest NRI servicing course for radio, FM, television with advanced lessons in servicing. All inquiries answered. J. Clifton Shears, Cresaptown, Md.

FOR SALE — IF transformer assemblies. 6SJ7 tube free with each $3 purchase. Write for details. L. G. Barrett, 80 Penn. Ave., New Britain, Conn.

FOR SALE — Hallicrafters S22R; Emerson portable, $12; Universal auto radio, $25; 1939 Chevrolet radio, $25; 1939 Buick radio, $21; Philco model AR5 auto radio. All working. Express Collect. N. Gregory, 36 Lenox Rd., Peabody, Mass.

SELL OR TRADE — Books by Ghirardi; Walsco heavy duty stapler; 3 220 watt fluorescent fixtures, complete; Hammond electric clock, no case; Penocsolite signal generator. Marvin Cohen, 104 So. Maryland Ave., Atlantic City, N. J.

SELL OR TRADE — Sam's Photofact Folios from 1 to 20, good as new. Want Superior or Metropolitan 450 tube checker, in good condition. E. O. Norman, 2021 N. Houston St., Fort Worth, Tex.

FOR SALE — Precision model 844P, like new, $30; Triplett model 1185 tube tester, excellent condition, $20; Farnsworth 6 tube model BT-68 portable radio, $20. John Kozma, 3104 Wilkinson Ave., New York 61, N. Y.

FOR SALE — BC 348-Q communications receiver, like new, matching speaker, ready to operate on 110 volts, 60 cycles. Price, $80. M. R. Dalessandro, 376 Emerson Ave., Farrell, Pa.

FOR SALE — Radio City model 802-N tube and set tester, 1947 model, excellent, $60. Remington Deluxe model 5 portable typewriter, almost new, $75. Tommy Goodman, Box 68, Scottsville, Va.

FOR SALE — Radio equipment and supplies, manuals, etc., worth $575. Write for particulars. Richard E. Reed, Newmanstown, Pa.

SELL OR SWAP — Clark ¼" electric drill; 12 No. 2051 tubes; 4 No. 1612 tubes; 20 bathtub condensers. Sell, or trade for tube tester in good condition. L. L. Waite, Supply Dept., U.S.N. School, Bainbridge, Md.

SELL OR TRADE — Advance relay, type no. 850; 1616 vacuum tube; 2 Navy 12SN7GT. Want small fil. transformer, 110 to 6 volts; phono oscillator; turntable, motor and pickup. Ray Bomar, 304 Fourth St., Coulee Dam, Wash.

SWAP — 4 1C6, 2 1A4P, 1 2A4g, 1 1A6, and 1 19 tube for anything usable. City-wide Radio Service, 822 Western Ave., N. S., Pittsburgh, Pa.

WANTED — Latest model radio-phono combination console. Advise as to price and model. George Pasquale, 9421 Thornhill Road, Silver Spring, Md.

WANTED — Position in radio-television industry. Graduate of Jersey City Technical Institute, familiar with all types of sets. D. Ascoli. 232 Van Horne St., Jersey City, N. J.

SELL OR TRADE — Weston V-U meters and Daven decade attenuators. Want audio oscillator, signal generator, oscilloscope. Will buy, sell or trade. M. R. Lerner, 772 S. 19th St., Newark, N. J.

FOR SALE — Tube tester; V.O.M. meter; radio tubes; radio parts; signal generator. At wholesale prices. Hastings Electrical Supply Co., 117 So. Jefferson, Hastings, Mich.

SELL OR TRADE — Rubber stamps, gummed sticker, embossed cards, etc. Prices free, or trade for radio parts, books, etc. J. T. Cookson, Lock Box 0, Puxico, Mo.

SELL AND WANTED — Set of 3 Coyne Electrical & Radio Reference Encyclopedia. Price, $5 each, or $12.50 for the set. Want to buy tube tester, signal generator, and V.T.V.M. Buskey's Radio Service, Peru Rd., Plattsburg, N. Y.

WANTED — Any or all of Riders volumes 1 through 16. Park Hill Radio Service, 113 Bennett St., East Syracuse, N. Y.

FOR SALE — 2 RCA 74B Junior Velocity mikes; Turner 101C cardiac mike; Turner 211 dynamic mike; RCA 90A program mike stand; RCA Mi-6203 3-section floor stand; Collins 6X1 line or monitoring amplifier. All like new. C. U. Smith, Box 156, Plainfield, Iowa.

FOR SALE AND WANTED — Used test equipment and sound systems for sale. Write for list. Want good used television receiver, standard brand or kit construction. Send complete information. Fox Radio Service, 126 South 6th St., Richmond, Ind.

WANTED — .22 caliber target pistol or small women's automatic. Will pay cash or trade radio tubes, resistors, condensers or other radio parts. Stathis Linardos, 190 Wadsworth Ave., New York 33, N. Y.

FOR SALE — Revere model 88 8 mm., f.2.5 camera; De Jur model 1000 750 watt bulb with deluxe carrying case. Both like new, guaranteed. Best offer. Louis Fialkoff, 143-48 41 Ave., Flushing, L. I., N. Y.

FOR SALE — Cinaudagraph P.M. speaker, 2 inch diameter cone, 3 ohm impedance, good condition; also RCA tubes IR5, IT4, IS5, IS4 in original cartons. B. Sichler, 362 Myrtle Ave., Irvington, N. J.

SELL OR TRADE — Isolation transformers, good for servicing hot A.C.-D.C. chassis. Need Riders Manuals or what have you? J. Defrees, 15 De Windt St., Beacon, N. Y.

FOR SALE — Radio repair and sales store, with electrical appliances and all equipment. Located in the heart of business section. Selling price, $7,000. Call in person, after 6 P.M. Radio Clinic, 527 S. Clinton Ave., Trenton, N. J.

SELL AND WANTED — Meissner recorder, perfect, one dynamic and one crystal mike, for sale. Want data, wiring diagram, or instruction manual for Signal Corps BC-1287 oscillograph. Julio Bellber Arroyo, c-o Pan American Airways, San Juan, Puerto Rico.

FOR SALE — Argus C-3, 35 mm. camera, complete; Weston Master II exposure meter; projector for C-3 film. All A-1. Price, $100 plus transportation. L. Putnam, Woodward, Iowa.

FOR SALE — Books in excellent condition. Audel's Radioman's Guide, Terman's Radio Engineering, Sterling's Radio Manual, Halloran's Television with Cathode Rays, and 10 volume World Survey Encyclopedia. $50 postpaid. L. J. Rios, 229 West 47 St., Los Angeles 37, Calif.

SELL OR TRADE — 7Y4 and 7F7 tubes in sealed cartons, 50 cents each. Will sell from 10 to 100 tubes, plus postage. What have you to offer? Sherman Heaton, Box 474, Albertville, Ala.

SELL AND WANTED — Solar CE-160 capacitor analyzer, $50; RCA voltohmyst, $45. Want Rimco Dysolyzer or late model Supreme Andolyzer 562 in new condition. Paul Capito, 637 W. 21 St., Erie, Pa.

FOR SALE — G.E. self charging portable radio, model 250. Perfect condition, $75. Peter A. Loesch, 25 W. 84th St., New York, N. Y.

FOR SALE — Model 502 Supreme tube checker and analyzer, completely modernized; Hawaiian electric guitar and amplifier mike and stand; all kinds of radio parts. Want 200 to 400 kc. transmitter, 8mm. movie camera and projector. W. A. Mackey, 307 N. Spring St., Tupelo, Miss.

SELL OR TRADE — Old model ABC Unameter tube tester, $17. Does not check octal tubes. Will trade for phonograph. Don O'Neil, 5034 Attleboro St., Jacksonville, Fla.

FOR SALE — Hallicrafters S-41-W. Make offer. All letters answered. Frank Nagy, Mary Ella Hall, Kannapolis, N. C.

TRADE — Univex Mercury camera, model 1, no carrying case. Uses geared spools and 35 mm. film. Will trade for standard tubes, condensers, or parts. Gregory H. Swiska, 109 East School St., Woonsocket, R. I.

SELL OR SWAP — German Shuer Chromed automatic pistol, 32 cal., perfect working condition. Trade for P.A. system trumphets or P. A. system equipment. Best offer. George Dvorak, Montgomery, Minn.

FOR SALE — Radio Course. I.C.S. books on receiving and transmitting circuits, motors, generators, batteries, drawing outfit for drafting. Make offer. Fran's Radio Service, 1787 E. Rodney Fr. Blvd., New Bedford, Mass.

SELL OR TRADE — R.C.P. model 322 portable tube tester, like new, $45; Precision 832-A multi-range V.O.M., $20. Will trade both instruments for good portable typewriter or Colt .22 automatic pistol. Maurice G. Gillette, Box 32, Scanlon, Minn.

WANTED — Wiring diagram and other data to the BC-1158 Bendix target transmitter. R. J. Keller, 4251 W. Irving Park Road, Chicago 41, Ill.

SELL OR TRADE — Sprayberry Radio and Television Course, practically new. Make offer. Interested in complete law library or course. Ernest Arsenault, No. Oxford, Mass.

FOR SALE — Zenith 6 volt wind charger, perfect condition, $17.50; Zenith 6 volt all wave radio, $20. Various makes of 4 and 5 tube battery radios, $29.95; 5 tube, 110 volt A.C.-D.C., $19.95. Lester M. Wycoff, Marmaduke, Ark.

SELL OR TRADE — One 1/3 H.P. and two 1/4 H.P. 25 cycle, 110 volt motors, set of Machinist Library, and twin arc sun lamp. Want Riders Manuals or test equipment. N. Englund, 1032 Hoyt 59, Muskegon Heights, Mich.

FOR SALE — Edwards FM tuner, BC-404C with tubes; Silver model 800 2 and 1 meter receiver. Want good 5 meter converter, hi-fidelity broadcast tuner, panoramic receiver. Paul West, Box 722, Martinsburg, W. Va.

FOR SALE — Used radio tubes, all numbers, any quantity. Good condition, tested by tube checker, 25 cents each. L. Wszolek, 3220 Co. Morgan St., Chicago 8, Ill.

FOR SALE — RTL model 120 tube and battery tester. Best offer. Crose Radio, 102 N. Clifton, Park Ridge, Ill.

SELL OR TRADE — Testrite model B-45 signal generator, good condition. Will trade for radio and electronic books. G. C. Estes, Jr., York, S. C.

SELL OR TRADE — One tube Pal receiver; 5 tube Lafayette radio, A.C., two bands, with headphone attachment, excellent condition; 3 pairs of headphones. All letters acknowledged. Bernard Krinsky, 1558 East 19th St., Brooklyn 30, N. Y.

FOR SALE — Readrite model 430 tube tester, excellent operating condition. Paint on face of tester is badly scratched but still quite readable. Best offer. Gene Achenbach, P.O. Boy 55, Unionville, Mich.

WANTED — Copies of Cooke's "Mathematics for Electrician and Radiomen." Will buy four copies; best offer. George Kinkade, 1211 Market St., Wilmington 41, Del.

SELL OR SWAP — Thor "1/4" electric screw driver motor, good condition. Want Riders Manual, XIV, XV, or what have you? Also have Topping "100" prefabricated Aluminum U Control Plane, $10. Jayel Hobby Shop, 212 Grand St., Brooklyn 11, N. Y.

WANTED — Collins 32V-1 150 watt amateur transmitter, used or damaged. John Czeszcicki, 2912 E. 123 St., Cleveland 20, Ohio.

WANTED — A 35 mm. camera. Will trade radio tubes and parts, test equipment; will add cash if needed. Describe. M. Gershowe, 147 Chester St., Brooklyn 12, N. Y.

SELL OR SWAP — Precision E-200 signal generator, NRI course books, miscellaneous radio books. All for $80 prepaid. Consider swap for photo or sport (golf or other) equipment. Joseph Miller, 116-B Alzona Park, Phoenix, Ariz.

WANTED — Amertran 6200 volt transformer or similar. Also meters, chokes, etc. Have miniature tubes for sale or trade. Can use photographic gear. J. E. Howell, Gen. Del., Gastonia, N. C.

WANTED — Partner to go in with for some sort of light manufacturing. All correspondence kept in strictest confidence. Milton Maultasch, 535 Grand St., Brooklyn 11, N. Y.

WANTED — Camera, still or movie. Have radio tubes, parts, some test equipment, plus cash if necessary. Describe. H. Gurse, 147 Chester St., Brooklyn 12, N. Y.

FOR SALE — Delco electric motors, refrigerator type, capacitor start, $15; GE 1/6 H.P. bench motor, $12. B. Nastoff, 3885 Washington St., Gary, Ind.

WANTED — Any or all Riders Manuals except abridged volume. Will pay any reasonable figure. Nu-Day Appliance, 704 Park Ave., Syracuse 4, N. Y.

WANTED — Stancor 6 volt power pack. Give full particulars in first letter. Paramount Radio Clinic, 275 Bates St., New Bedford, Mass.

WANTED — Sylvania model 140 tube checker or Precision tube tester. Cash. Chas. S. Brotzman, 173 Main St., Mexico, Me.

WANTED — Operating and maintenance manuals for Navy transmitter GO-9, series 784. Charles S. Storer, 726 Third St., Elizabeth, Pa.

FOR SALE — Precision E200 signal generator, new condition; Precision 954G tube and set checker; Riders Manuals 1 to 5, like new; adjustable transformer; RCA record changer, good condition; meters. E. Vockeroth, 1746 N. Campbell Ave., Chicago 47, Ill.

TRADE — Complete set of "Mechanics Universal Aviation Service" books, for signal generator. Includes 10 books covering aircraft engines, planes, navigation, meteorology, and civil air regulations. J. Pomichter, 86 E. Park Rd., Grand Island, N. Y.

SWAP OR SELL — Meissner phono-oscillator; 1947 subscription of "Electrical World," 52 issues; $50 worth of "O" gauge model railroad equipment. Want dynamic microphone and radio test equipment. F. A. Wheaton, Box 27, Poquonock, Conn.

TRADE — Radio test equipment for Indian 4 motorcycle, 1940 up, or cash. Harry Kay, Route 2, Box 255, Imlay City, Mich.

WANTED — Antenna coil assembly for model 5G461 Zenith radio, part no. S7257. Cash. Midway Electrical Co., Box 161, Ellsworth, Minn.

SELL OR TRADE — E200 Precision signal generator, $47.50; 504-A Supreme tube and set tester, $42.50. Both instruments perfect. Converted Hickok dynamic conductance tube tester, takes 117 series, $32.50. Martin's Radio Shop, 313 East Main St., Barstow, Calif.

SWAP — 50 watt CW transmitter complete, battery charger, portable radio, PA system, 0-3 D.C. voltmeter, television (Transvision) R.F. section, for enlarger, movie camera or projector, or what have you? Stanley Zuchora, 2748 Meade St., Detroit 12, Mich.

FOR SALE — Triplett tube tester, model 1210A with two compartment carrying case, $20. D. C. Overholt, 768 Francisco St., San Francisco 11, Calif.

SELL OR TRADE — GE LB-530X portable radio; Gruen 0-500 ma. D.C. meter; hand operated Moto-saw; 5th Edition "Mallory Radio Service Encyclopedia." Need Hallicrafter's "Skyrider Jr." receiver and C-D capacitor bridge. Paul W. Connor, Box 504, St. Maries, Idaho.

FOR SALE — Supreme model 85 tube tester, portable carrying case, materials for modernization adapters, $20; Army Command set receiver, rewired for 6 volt operation and 6V6 output stage, no speaker, $20. Wm. E. Cronquist, Como Station, Route 3, St. Paul 8, Minn.

WANTED — 25D8, 25B8, and 70L7 tubes. Have radio parts to trade, also 2 telephone handsets in factory cartons. L. Jolivet, 6 Marshall St., Haverhill, Mass.

FOR SALE AND WANTED — GE ¼ H.P. motor, $16; late model Solar capacitor analyzer, CE-160, $50. Want model OMA Clough-Brengle signal generator; RCA frequency modulator. Paul Captio, 637 W. 21 St., Erie, Pa.

WANTED — Kolster power transformer for a model K-24 using tubes 4-26, SI-27, 2-81, A210. State price. H. M. Schroeder, 2209 E. Monument St., Baltimore 5, Md.

SELL OR TRADE — Chevrolet model 364441, $20; Truetone 6018-2, $40; Rehtron model V25 burglar alarm, $25. Want late tube tester or signal generator. Harry's Service, 3059 W. 103 St., Cleveland 11, Ohio.

FOR SALE — Electrical appliance store, radio service and wiring business. Excellent location in small town in central Ohio. Operated successfully for 10 years. Leaving on account of health. Phil's Electric Shop, Utica, Ohio.

FOR SALE — 100 watt CW transmitter, 80-40 meters, band-switching, voltage-regulated V.F.O., power supply. Price complete, $125. Also 30 watt Xtal CW transmitter, $35. Larry Steeg, 22 W. 91st St., New York 24, N. Y.

FOR SALE — Triumph model 333S multi-range meter, complete with batteries and instructions, metal carrying case, perfect working condition, $20. Stewart A. Barnum, 1541 E. 56th St., Brooklyn 10, N. Y.

WANTED — Young man, 24, wishes to contact technicians in U.S.A. for exchange of technical ideas about radio. T. A. Bergman, J. Evertrensenstr 2, Haarlem, Holland.

SWAP — 21 piece York bar-bell set including iron shoes, trap drum. Am interested in paint spray outfit, power tools and electronic instruments. George Lang, 307 Hanover St., Bethlehem, Pa.

FOR SALE — BC-654 complete with power supply, $35; "Handy Talky," $38; electrolitic and bypass condensers, $30 worth for $10. Arvid Holt, P. O. Box 1702, Fosston, Minn.

FOR SALE — Sprayberry Radio, Television, and FM course, in good condition. No equipment included, $25. John O. Rigo, 259 2nd Ave., Laurel Gardens, Pa.

FOR SALE — Mark II phone-CW transmitter-receiver, converted and revamped for A.C., complete. Best offer. Stewart Suttenberg, 2410 Beverly Road, Brooklyn 26, N. Y.

FOR SALE — Readrite model 432A tube tester, excellent condition, $22; N.R.I. Servicer, model 1175-B meter, needs minor repairs and batteries. Price, $25. Andrew Ogorzalek, Lublin, Wis.

FOR SALE — Precision E200 signal generator, $52; Superior model 450 tube tester, $29; Triplett model 625N, V.O.M., $37.50. These instruments are like new. Emil Altenbach, Route 11, Box 345-K, Cincinnati 31, Ohio.

SELL OR TRADE — Riders Manuals, abridged volumes 1 to 5, like new, $15 postpaid, or sent C.O.D. for $14.25. Will trade, make offer. All inquiries answered. Sweeney's Radio Service, 462 West 7th St., Winona, Minn.

SELL OR SWAP — Radio tubes at 75 cents each, any amount. Write for list. Iannaccone's, Box 291, Litchfield Park, Ariz.

FOR SALE — Two Leonard refrigerator cooling fan motors. Delco type S.S.T., model A6590, like new, less fan, $3.50 each, postpaid. 97 2¼" glass strain aerial insulators, $1.50; 75 2¾" glass strain aerial insulators, $2, plus transportation. James Wodjick, 65 Main St., (Inkerman) Pittston, Pa.

SELL OR SWAP — Various frequency meters, tubes, components, etc. Send for list. Milton Kalashian, 2 Congress St., Newburyport, Mass.

FOR SALE — Large list of tubes for tube collectors. Write for list. Walters Radio Service, Paoli, Ind.

SELL OR SWAP — Meissner phono, radio, recorder, and PA system, $160. Want 7" television kit. Paul G. Roy, Charlton City, Mass.

FOR SALE — Large assortment of guaranteed radio tubes. Goodwin Radio Shop, Rankin, Ill.

FOR SALE — Latest N.R.I. Course, $25; Howard Sam's diagrams, sets 1-6, $5. Both like new. Frank Wurst, 242 Dayton Ave., Clifton, N. J.

SELL OR TRADE — 110 volt D.C., 1/6 H.P. washing machine motor; 16" D.C. fan and motor; 1/20 H.P., 230 volt, D.C. motor, etc. Want aluminum washing machine drum or test equipment. F. Dlouhy, 1814 S. Normal Ave., Chicago 16, Ill.

FOR SALE AND WANTED — Panel fuseholders, 3AG, 9 for $1; .5 meg. controls, Allen Bradley composition, 5 for $1. Want Crosley "Pup" receiver, two 182B-482B tubes; schematic and parts specifications for Shaub "Weltsuper 40." Wells Radio, 32 Gage Ave., Glens Falls, N. Y.

SELL OR TRADE — Delco 6 volt battery set, standard, foreign, police, aviation, and amateur bands. Best offer, or would like wire recorder. Have 8 watt fluorescent bed lamps, $8 prepaid. Richard Firmature, P.O. Box 528, Lake Charles, La.

SELL OR TRADE — Complete set of NRI radio and television courses. Want communications receiver, test equipment, or what have you? J. G. Hoyt, 304 E. Dudley Ave., Westfield, N. J.

WANTED — A copy of U. S. Army publication "Radar Electronic Fundamentals, TM11-466," in good condition. Joseph Shulman, 600 Logan St., Brooklyn 8, N. Y.

FOR SALE AND WANTED — 10 watt amplifier, mike and phono input, separate controls, 8" speaker, like new, $20, or sell separate. Want "Radio Operating Questions and Answers" book, by Nilson & Hornung. John Cook, Park Sta., Box 2294, Waynesboro, Va

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FOR SALE — Jensen Coaxial HNP-51 in Jensen bass reflex walnut RD-151. Perfect condition, $90 complete. Charles Robert Schwartz, 1975 Sedgwick Ave., New York 53, N. Y.

FOR SALE — 16 mm. Keystone projector B63 with 2050 ft. film. F:2.5 lens, 2" focus. Very good condition. Best offer. Warren Schroeder, 78-34 160 St., Flushing, L. I., N. Y.

WANTED — Unused U. S. postage stamps in quantity. Will trade for radio and gift items. G. Samkofsky, 527 Bedford Ave., Brooklyn 11, N. Y.

TRADE OR SELL — Complete set LaSalle extension university "Business Management Executive Manuals," 100 manuals bound in 48 volumes, like new. Want Riders or Sam's Manuals, or test equipment. M. M. Valentine, P.O. Box 24, Laredo, Tex.

SWAP — Assistance in supplying British radio gear in exchange for a similar service from U.S.A. G. R. Pearce, 102 Kingshill Rd., Twindon, Wilts., England.

WANTED — RCA model T5-2 5 tube superhet.; Philco model 37-84 4 tube superhet.; Emerson model BA-199 5 tube A.C.-D.C. TRF receiver. Anthony R. Castro, 1876 West 14th Ave., Denver 4, Colo.

FOR SALE — Corona No. 3 portable typewriter. Perfect condition, $25. Geo. Kaufer, 1933 E. 14 St., Brooklyn 29, N. Y.

FOR SALE — RCA Rider Chanalyst, model 162-C, like new, $100; Triplett model 2413 tube tester, $30; Supreme vacuum tube voltmeter, model 565, perfect, $40. J. W. Hallinan, 801 St. George Ave., Roselle, N. J.

SELL OR TRADE — Model 6V62 Zenith Console, 3 band, operates on 6 volt storage battery, good condition; Silvertone model 6045 6 tube battery set. Sell, or trade for PA equipment. Fenton L. Bradshaw, 122 Morgan St., Suffolk, Va.

FOR SALE — Round head brass machine screws at 5 cents per doz., 50 cents per gross; 1½" no. 8 round head blued wood screws, 4-40 x ½" flat head brass machine screws, 40 cents per gross. S. Clarke, 35 Ross St., Williamsport 10, Pa.

FOR SALE — Precision E-200 generator, $50; Simpson model 260 multimeter, $40; signal tracer like Superior CA-11, $10; Apex Video sound adapter for 16 mm. silent movie projector, $25. All like new. F. Fellows, 45-27 170th St., Flushing, N. Y.

SELL OR TRADE — Chrome Vanadium tools, all sizes box and end wrenches, pliers, screwdrivers; American Beauty 100 watt soldering irons; micrometers. Want modern test equipment, record changers, etc. Roby's Swapmart, 1119 Milwaukee Ave., Chicago 22, Ill.

SELL OR TRADE — RCA Junior Velocity microphone, like new, chrome plated, $25; chrome flood stand, $5; complete, $35; Mark II trans.-receiver; Castle sound films, $10 reel; phono records, 3 for 25 cents. R. Bond, 2637 Westminister Ave., Dallas 5, Tex.

FOR SALE — Several Triumph 3 inch cathode ray oscillographs in original packing. 115 volts, 60 cycles, wide linear sweep, $60 each. E. J. Doyle, 20 E. Ayres Ave., Hinsdale, Ill.

SELL OR TRADE — Nacometer automatic code transmitter, in excellent condition. Cash or trade for Riders service manuals of a late date. Lakeview Radio Service, 4807 Pitt St., Duluth, Minn.

FOR SALE — F.B.K.W. rack and panel CW rig, 3 power supplies. B & W plug-ins all link coupled, 11 3¼" Jewell meters. Write for details. Charles W. Nicholson, 138 Main St., Holden, Mass.

HOW NEW FM DETECTORS WORK

(Continued from page 5)

a reduction in the voltage across C4 in the same way. The constant voltage across C6 can be considered to be a stabilizing voltage, i.e., it stabilizes the ratio detector output against amplitude modulation of the applied carrier.

The time constant of R3-C6 is not too large to prevent average changes in carrier level from appearing as changes in voltage across R3; in other words, the voltage across R3 is proportional to the average strength of the received carrier. Thus, this voltage serves as an excellent AVC voltage.

There is no "threshold" effect apparent in the ratio detector. That is, there is no minimum carrier level which must be applied to the detector to cause noise attenuation as in other types of FM detectors requiring the use of a limiter stage.

Another postwar development in FM second detectors is the locked oscillator circuit which is also inherently insensitive to amplitude impulses and, therefore, does not require the conventional limiter stage.

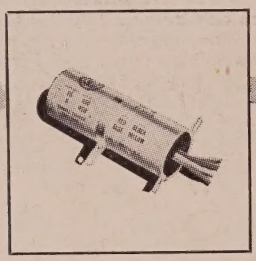
Figure 4 shows the schematic diagram of a typical locked oscillator circuit. A special tube is used, one section of which operates as a modified Colpitts oscillator at the intermediate frequency. The IF amplifier output is fed into the injection grid of the same tube and the coupling between the two circuits causes the oscillator to lock in and follow the variations in frequency of the IF signal. As the oscillator frequency decreases, the plate current through R1, the audio load resistor increases, and as the oscillator frequency increases, the plate current decreases. These current variations are linear with respect to the frequency deviation of the applied IF signal and the plate current therefore reproduces the same wave shape as the modulation of the incoming FM signal. This audio signal is then fed into the audio stages through the de-emphasis network.

a "plug" from our good friend, the C-D serviceman...

HAROLD E. SANTASIERE of New York City
keeps C-D's on tap for dependable service

Harold says: " ... receiving your publication for over 6 years...my appreciation for the many valuable aids. Consistent user of your products and find in the many years of servicing that C-D's have held up remarkably well... considerable life span... known to give up to five years' service where they have not been abused, and still going strong."

C-D says: Many thanks for your compliments, Harold. We feel well rewarded when servicemen like yourself write us such fine C-D testimonials daily of their own accord.



Type EZ cardboard tube dry electrolytic capacitor, typical of C-D quality units for low cost replacements.

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